CLAIMS

1. A method of treating a substrate, comprising: applying a layer of at least one metal to the substrate of an unassembled component of a structure to form an applied metal layer on the substrate and curing the applied metal layer at sub-atmospheric pressure prior to assembly of the structure to form a metal protective layer on the substrate, wherein the applied metal layer is cured in a reducing environment.

2. A method of treating a substrate, comprising: applying a layer of at least one metal to the substrate of an unassembled component of a structure to form an applied metal layer on the substrate, curing the applied metal layer at a first temperature and a first pressure for a first period of time, and curing the applied metal layer at a second temperature and second pressure for a second period of time, wherein the curing forms a metal protective layer on the substrate, wherein the applied metal layer is cured in a reducing environment, wherein the first pressure, second pressure, or both are sub-atmospheric.

3. A method of treating a substrate, comprising: applying a layer of at least one metal to the substrate of an unassembled component of a structure to form an applied metal layer on the substrate and followed by curing of the applied metal layer at a sub-atmospheric pressure and at a temperature of greater than about 1,200°F (649°C) to form a metal protective layer on the substrate, wherein the applied metal layer comprises tin oxide, a decomposable tin compound, and tin metal powder, wherein the applied metal layer is cured in a reducing environment, wherein the first pressure, second pressure, or both are sub-atmospheric.

4. The method of claim 1, wherein the applied metal layer is cured at a pressure of from about 14 psia (97 kPa) to about 1.9×10^{-5} psia (0.13 Pa).

5. The method of claim 1 or claim 2, wherein the applied metal layer is cured at a temperature of from about 600°F to about 1,400°F (760°C).

6. The method of claim 1, wherein the applied metal layer comprises tin, antimony, bismuth, silicon, lead, mercury, arsenic, germanium, indium, tellurium, selenium, thallium, copper, chromium, brass, intermetallic alloys, or combinations thereof.

7. The method of claim 1, wherein the applied metal layer has a thickness of from about 1 mil (25 μm) to about 100 mils (2.5 mm).

8. The method of claim 1, wherein the metal protective layer has a thickness of from about 1 μm to about 150 μm.

9. The method of any one of claims 1 to 3, further comprising contacting the metal protective layer with a mobilization agent followed by a sequestration process.

10. The method of any one of claims 1 to 3, wherein the metal protective layer further comprises a nickel-depleted bonding layer.

11. The method of claim 10, wherein the bonding layer comprises stannide.

12. The method of claim 10, wherein the bonding layer has a thickness of about 1 to about 100 μm.

13. The method of claim 10, wherein the bonding layer comprises from about 1 wt% to about 20 wt% elemental tin.

14. The method of claim 1, wherein the unassembled component of the structure is an unassembled component of a reactor system.

15. The method of claim 1, wherein the application of the layer of at least one metal, the curing of the applied metal layer, or both is performed at a location other than a final assembly site for the structure.

16. The method of claim 1, wherein the unassembled component is transported prior to or after applying the at least one metal layer; prior to or after curing of the applied metal layer; or prior to or after further contacting the metal protective layer with a mobilization

agent followed by a sequestration process.

17. The method of claim 1, wherein the unassembled component is removed from an assembled structure prior to the application of the at least one metal layer.

18. The method of claim 1, wherein the unassembled component is a repair or replacement part for an assembled structure.

19. The method of claim 14, wherein the applying of the layer of at least one metal to the substrate of the unassembled reactor system component requires less reactor system downtime when compared to an otherwise identical method wherein the layer of at least one metal is applied to an assembled like component of the reactor system.

20. The method of claim 1, wherein the curing of the applied metal layer is at sub-atmospheric pressure.

21. The method of claim 2, wherein the first temperature is from about 600°F to about 1,400°F (760°C) and the first pressure is from about 215 psia (1,480 kPa) to about 1.9×10^{-5} psia (0.13 Pa).

22. The method of claim 2, wherein the second temperature is from about 600°F to about 1,400°F (760°C) and the second pressure is from about 1.9×10^{-5} psia (0.13 Pa) to about 215 psia (1,480 kPa).

23. The method of claim 2 or 3, wherein the substrate is an unassembled component of a structure and the applied metal layer is cured prior to assembly of the unassembled component into the structure.

24. The method of claim 3, wherein the metal protective layer comprises a stannide and the stannide layer has a thickness of from about 0.25 μm to about 100 μm.

25. The method of claim 1, claim 2 or claim 3, substantially as hereinbefore described.

26. A process for manufacturing a petrochemical product comprising: introducing a

feedstock into a reactor; reacting the feed stock in the reactor in the presence of a catalyst; wherein the reactor comprises the metal protective layer produced by the method of any one of the preceding claims.

CLAIMS

1. A method of treating a substrate, comprising: applying a layer of at least one metal to the substrate of an unassembled component of a structure to form an applied metal layer on the substrate and curing the applied metal layer at sub-atmospheric pressure prior to assembly of the structure to form a metal protective layer on the substrate, wherein the applied metal layer is cured in a reducing environment; and wherein the substrate comprises carbon steels, mild steels, alloy steels, stainless steels, or austenitic stainless steels, or combinations thereof.

2. A method of treating a substrate, comprising: applying a layer of at least one metal to the substrate of an unassembled component of a structure to form an applied metal layer on the substrate, curing the applied metal layer at a first temperature and a first pressure for a first period of time, and curing the applied metal layer at a second temperature and second pressure for a second period of time, wherein the curing forms a metal protective layer on the substrate, wherein the applied metal layer is cured in a reducing environment, wherein the first pressure, second pressure, or both are sub-atmospheric.

3. A method of treating a substrate, comprising: applying a layer of at least one metal to the substrate of an unassembled component of a structure to form an applied metal layer on the substrate and followed by curing of the applied metal layer at a sub-atmospheric pressure and at a temperature of greater than about 1,200°F (649°C) to form a metal protective layer on the substrate, wherein the applied metal layer comprises tin oxide, a decomposable tin compound, and tin metal powder, wherein the applied metal layer is cured in a reducing environment, wherein the first pressure, second pressure, or both are sub-atmospheric.

4. The method of claim 1, wherein the applied metal layer is cured at a pressure of from about 14 psia (97 kPa) to about 1.9x10-5 psia (0.13 Pa).

5. The method of claim 1 or claim 2, wherein the applied metal layer is cured at a temperature of from about 600°F (316°C) to about 1,400°F (760°C).

6. The method of claim 1, wherein the applied metal layer comprises tin, antimony, bismuth, silicon, lead, mercury, arsenic, germanium, indium, tellurium, selenium, thallium, copper, chromium, brass, intermetallic alloys, or combinations thereof.

7. The method of claim 1, wherein the applied metal layer has a thickness of from about 1 mil (25 μm) to about 100 mils (2.5 mm).

8. The method of claim 1, wherein the metal protective layer has a thickness of from about 1 μm to about 150 μm.

9. The method of any one of claims 1 to 3, further comprising contacting the metal protective layer with a mobilization agent followed by a sequestration process.

10. The method of any one of claims 1 to 3, wherein the metal protective layer further comprises a nickel-depleted bonding layer.

11. The method of claim 10, wherein the bonding layer comprises stannide.

12. The method of claim 10, wherein the bonding layer has a thickness of about 1 to about 100 μm.

13. The method of claim 10, wherein the bonding layer comprises from about 1 wt% to about 20 wt% elemental tin.

14. The method of claim 1, wherein the unassembled component of the structure is an unassembled component of a reactor system.

15. The method of claim 1, wherein the application of the layer of at least one metal, the curing of the applied metal layer, or both is performed at a location other than a final assembly site for the structure.

16. The method of claim 1, wherein the unassembled component is transported prior to or after applying the at least one metal layer; prior to or after curing of the applied metal layer; or prior to or after further contacting the metal protective layer with a mobilization agent followed by a sequestration process.

17. The method of claim 1, wherein the unassembled component is removed from an assembled structure prior to the application of the at least one metal layer.

18. The method of claim 1, wherein the unassembled component is a repair or replacement part for an assembled structure.

19. The method of claim 14, wherein the applying of the layer of at least one metal to the substrate of the unassembled reactor system component requires less reactor system downtime when compared to an otherwise identical method wherein the layer of at least one metal is applied to an assembled like component of the reactor system.

20. The method of claim 2, wherein the first temperature is from about 600°F (316°C) to about 1,400°F (760°C) and the first pressure is from about 215 psia (1,480 kPa) to about 1.9x10-5 psia (0.13 Pa).

21. The method of claim 2, wherein the second temperature is from about 600°F (316°C) to about 1,400°F (760°C) and the second pressure is from about 1.9x10-5 psia (0.13 Pa) to about 215 psia (1,480 kPa).

22. The method of claim 2 or 3, wherein the substrate is an unassembled component of a structure and the applied metal layer is cured prior to assembly of the unassembled component into the structure.

23. The method of claim 3, wherein the metal protective layer comprises a stannide and the stannide layer has a thickness of from about 0.25 μm to about 100 μm.

24. A process for manufacturing a petrochemical product comprising: introducing a feedstock into a reactor; reacting the feed stock in the reactor in the presence of a catalyst; wherein the reactor comprises the metal protective layer produced by the method of any one of the preceding claims.